NOVEMBER/DECEMBER 2024

23PEMA15B — MATHEMATICAL PROGRAMMING

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Time : Three hours Maximum : 75 marks

SECTION A — (10 × 2 = 20 marks)

Answer ALL the questions.

1. Define pure and mixed integer programming problems.

2. What is state variable?

3. Write the Kuhn-Tucker necessary condition.

4. Define quadratic programming.

5. Explain the meaning of basic feasible solution.

6. Write the standard form of an LP problem in the matrix form.

7. Consider the LP problem in its standard form using revised simplex method.

8. Define basic variable.

9. Write a short note on parametric linear programming.

10. Define General goal lineear programming.

SECTION B — ($5 \times 5 = 25$ marks)

Answer ALL the questions.

11. (a) Solve the following integer LP problem using the cutting plane method

Max $z = 2x_1 + 20x_2 - 10x_3$

Subject to the constraints

$2x_1 + 20x_2 + 4x_3 \leq 15$

$6x_1 + 20x_2 + 4x_3 = 20$

$x_1, x_2, x_3 \geq 0$ and integer

Or

(b) Explain steps of Gomory's mixed-integer programming.

12. (a) Use Wolfe's method to solve the quadratic programming problem.

Max $z = 4x_1 + 6x_2 - 2x_1^2 - 2x_1x_3 - 2x_2^2$

Subject to the constraints

$x_1 + 2x_2 \leq 2$ and

$x_1, x_2 \geq 0$

Or

19. Use the revised simplex method to solve the following LPP.

Maximize $z = 3x_1 + 5x_2$

Subject to the constraints

$x_1 \leq 4, x_2 \leq 6, 3x_1 + 2x_2 \leq 18$ and $x_1, x_2 \geq 0$.

20. Explain modified simplex method of goal programming.

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(b) Solve the following problem by using the method of Lagrangian multipliers

Minimize $z = x_1^2 + x_2^2 + x_3^2$

Subject to the constraints

$x_1 + x_2 + 3x_3 = 2$

$5x_1 + 2x_2 + x_3 = 5$ and

$x_1, x_2, x_3 \geq 0$

13. (a) Find all the basic feasible solutions to the system of linear equations $x_1 + 2x_2 + x_3 = 4, 2x_1 + x_2 + 5x_3 = 5$ are the solutions degenerate.

Or

(b) Prove that the set of all feasible solutions to an LP problem is convex set.

14. (a) Solve the following LP problem using revised simplex method

Max $z = 2x_1 + x_2$

Subject to the constraints

$3x_1 + 4x_2 \leq 6$

$6x_1 + x_2 \leq 3$

and $x_1, x_2 \geq 0$

Or

(b) Solve the following LP problem using revised simplex method.

Max $z = 3x_1 + 2x_2$

Subject to the constraints

$x_1 - 3x_2 \leq 3$
$x_1 - 2x_2 \leq 4$
$2x_1 + x_2 \leq 20$
$x_1 + 3x_2 \leq 30$
$-x_1 + x_2 \leq 6$ and
$x_1, x_2 \geq 0$

15. (a) Consider the linear programming problem

Max $z = 3x_1 + 2x_2 + 5x_3$

$x_1 + 2x_2 + x_3 \leq 430 + \lambda, 3x_1 + 2x_3 \leq 460 - 4\lambda$,

$x_1 + 4x_2 \leq 420 - 4\lambda$, and $x_1, x_2 \geq 0$

Or

(b) A manufacturing firm produces two types of products A and B. The unit profit from product A is Rs. 100 and that product B is Rs. 50. The goal of the ear to total profit in the next week.

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SECTION C — (3 × 10 = 30 marks)

Answer any THREE questions.

16. Solve the following all integer programming problem using the branch and bound method

Maximize $z = 3x_1 + 5x_2$

Subject to the constraints

$2x_1 + 4x_2 \leq 25,\ x_1 \leq 8, 2x_2 \leq 10,$
$x_1, x_2 \geq 0$ and integers

17. Find the optimum solution of the following constrained multivariable problem

Minimize $z = x_1^2 + (x_2 + 1)^2 + (x_2 - 1)^2$

Subject to the constraints

$x_1 + 5x_2 - 3x_3 = 6$ and $x_1, x_2, x_2 \geq 0$

18. Given a basic feasible solution to the LP problem $X_B = B^{-1}b = (x_{B1}, x_{B2}, \ldots, x_{Bm})$ and $z = z^*$ such that $c_j - z_j \leq 0$ for every column a_j in A but not in B. Then prove that z is the maximum value of objective function z and X_B is an optimal basic feasible solution.